

Chapter 5.1

Fire safety

This could be you . . .

An office employee allowed an excessive amount of paper to accumulate around his work area. When a short developed in an electrical outlet, a fire quickly destroyed the office contents before the fire was extinguished.

1. Applicability of this chapter

You are required to follow this chapter if you work at JSC or a JSC field site. Paragraph 21 lists the responsibilities of Organizational Directors, Facility Managers, JSC's Center Director, and the Safety and Test Operations Division.

2. What this chapter covers

This chapter describes JSC's fire safety program and covers the actions that you need to take in your daily work activities to recognize possible fire risks, conditions that could cause a fire to develop and grow, and conditions that can interfere with safe and orderly evacuation in case of a fire.

You can find additional fire protection requirements in NASA-STD-8719.11, "Safety Standard for Fire Protection."

Fire safety program

3. JSC's fire safety program

JSC's fire safety program seeks to apply recognized standards to protect life and property from fire. It also provides standard procedures for evacuating buildings in case of a fire. A strong fire safety program also increases awareness of fire safety and fire hazards so that you can maintain a safe and healthy workplace and reduce the chance of death, injury, or property damage from fire. JSC's fire safety program covers four areas of fire protection: education, prevention, detection, and suppression. It provides consistent, comprehensive methods for JSC to prevent fires and deal with them if they happen. The program covers:

- a. Fire prevention, which includes:
 1. Management supporting and following fire rules, regulations, and codes.
 2. Education, training, and motivation of all employees in the causes and prevention of fires.

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3. Building fire warden program.
 4. Inspections of all work areas and other facilities to identify possible fire risks.
 5. Fire risk assessments of mission operations, test configurations, laboratory equipment, storage areas, flight hardware, essential data and records, and high-value or mission-critical equipment.
 6. Design and construction of buildings that limit the spread of fire and smoke.
 7. Fire drills, emergency evacuation plans, and emergency action plans.
- b. Fire detection, which includes:
1. Installing and maintaining smoke and heat detectors throughout buildings.
 2. Installing manual pull stations near outside exits and entrances to stairwells.
 3. Installing and maintaining alarms throughout buildings to notify occupants of a fire.
- c. Fire suppression, which includes:
1. Installing and maintaining sprinkler, Halon, clean agent, and carbon dioxide systems.
 2. Inspecting monthly and maintaining portable fire extinguishers.
 3. Training building fire wardens and their assistants to use fire extinguishers.

4. What you need to know about the JSC fire safety program

As a JSC employee, you shall take measures to prevent fires in your work area and react properly if a fire occurs. Be familiar with the requirements in this chapter. Other chapters in this Handbook cover parts of JSC's fire safety program as follows:

- a. Fire inspections and surveys – Chapter 2.5, "Routine Inspections"
- b. Fire wardens – Chapter 3.8, "Emergency Preparedness"
- c. Fire drills – Chapter 4.4, "Emergency Training"

5. Fire prevention plans

Each JSC building shall have a fire prevention plan that includes:

- a. A list of the major workplace fire hazards and procedures for properly handling and storing flammable or combustible materials.
- b. Potential ignition sources (such as welding, smoking, and others).
- c. Procedures for controlling the hazards and ignition sources to include the kinds of fire protection equipment or systems available in the building.
- d. Names or regular job titles of those personnel responsible for maintaining equipment and systems installed to prevent or control ignitions or fires.
- e. Names or regular job titles of those personnel responsible for controlling fuel source

- f. Housekeeping procedures to control accumulations of flammable and combustible waste materials and residues so that they do not contribute to a fire emergency.

6. Facility design, fire detection, and fire suppression

See Chapter 10.1, “General safety and health requirements for facility design, construction, and operation,” for fire safety requirements involving facility design, fire detection, and fire suppression.

Fire safety practices

7. Precautions to prevent fires

You shall follow good fire prevention practices to reduce the chance of a fire or to allow trained JSC personnel to deal with a fire. The following table describes many of these precautions and practices.

<i>For . . .</i>	<i>Follow this precaution . . .</i>
Access to buildings and emergency equipment	<ul style="list-style-type: none"> • Keep at least one-half the width, but not less than 16 feet (14 feet for existing buildings), of a service driveway open at all times to allow access by fire trucks. • Never park in areas marked with a yellow or red curb. • Never place or store any items of stock, furniture, equipment, recycle bins, janitor equipment, interior decorations, vehicles, debris, or other substantial physical objects in any exit routes such as a corridor, exit door, stairwell, or exit without the approval of the Safety and Test Operations Division. • Never place objects in locations that restrict ready access to or use of fire protection equipment such as fire extinguishers, alarm pull stations, hydrants, fire hose outlets, Siamese connections, fire alarm panels, or sprinkler riser valves. • Indicate the location of any fire extinguisher not readily visible using a sign with the lettering “Fire Extinguisher” above the fire extinguisher. Existing painted red squares are acceptable. Remove or paint over signs or red squares if the fire equipment is relocated or taken out of service. • Fire extinguisher signs located in corridors shall be visible from the ends of the corridor. • Put signs denoting “Fire Alarm” over fire alarm pull boxes when they are not readily visible from a distance.

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<i>For . . .</i>	<i>Follow this precaution . . .</i>
Hot work such as open flames, burning, cutting, or welding	<ul style="list-style-type: none">• Never have open flames in your work area without following the hot work requirements in Chapter 5.8, “Hazardous operations: safe practices and certification,” of this Handbook. The exception to this requirement is open flames or hot work in areas designed for it, such as Bunsen burners in laboratories or designate hot work areas. Keep combustible and flammable materials away from all open flames and hot work.• Follow Chapter 8.4, “Welding, cutting, and brazing safely,” of this Handbook.
Fire safety in construction areas, maintenance areas, work areas, and janitorial areas (includes offices and storage areas)	<ul style="list-style-type: none">• Keep at least an 18-inch clearance between the deflectors of sprinkler heads and materials or furniture below. This doesn’t apply to cabinets or shelving placed against a wall unless the shelving is directly under a sprinkler head.• Never use flammable liquids in janitorial operations. All janitorial supplies shall be stored in a safe manner, such as in closets or cabinets specifically designed for this purpose.

8. Smoking at JSC

Smoking is strictly prohibited inside all government-owned or -leased facilities. You may smoke in outdoor areas unless the area is posted as “no smoking” due to nearby hazardous activities or storage. Dispose of cigarette butts in ashtrays and make sure they are out. Limit smoking to ground-level locations to avoid the potential of cigarette butts falling from an outside balcony. Do not place paper or other combustibles in ashtrays or other cigarette receptacles.

9. Widths for exit routes

You shall arrange your work area to maintain the exit widths shown on the diagram in Attachment 5.1A, Appendix 5. Report any violations of the exit widths that you cannot control, such as doors or hallways, to your supervisor or facility manager. These are the minimum acceptable widths based on National Fire Protection Association Standard 101, “Life Safety Code.” The JSC Furniture Office may require wider exit widths to allow them to move furniture easily.

10. Maximum number of people permitted in a conference room or other assembly area to allow a safe exit in case of a fire

If there are too many people in a room or area, they may have problems evacuating safely if a fire occurs. As a facility manager, you shall calculate and post the maximum number of people allowed in each conference room or assembly area in your building. You may set the maximum posted occupant load at less than the load you calculate below. A fire protection engineer is available from the Safety and Test Operations Division to help you, if needed. Use these requirements to calculate and post the maximum occupant load. Normally, the load will be the number you calculate in subparagraphs a or b, but you may have to reduce the number based on your checks in subparagraph c:

- a. If the room has fixed seats (permanently attached to the floor), the maximum occupant load is the number of fixed seats unless you need to reduce the load based on your checks in subparagraph c below. Allow no one to sit or stand in the aisles.
- b. If the room doesn't have fixed seats:
 1. Find the net area of the room by calculating the area of the floor and deducting the square footage of any partitions, cabinets, conference tables, or other furniture that are not normally moveable. Do not deduct the square footage occupied by moveable chairs or other moveable furniture or equipment.
 2. Divide the net square footage of the room you calculated above by 12 feet² for a square room and 11.5 feet² for a rectangular room. This is the maximum occupant load of the room unless you need to reduce the load based on your checks in subparagraph c below.
- c. Check all of the following to see if you need to reduce the maximum occupant load you calculated in a or b above:
 1. If the exit doors have latches that are not operated by panic bars, the maximum occupant load is 99 persons or the number you calculated in a or b above, whichever is less.
 2. If the room only has one exit or if **any** exit doors swing into the room, the maximum occupant load is 49 persons or the number you calculated in a or b above, whichever is less.
 3. Divide the sum of the clear widths in inches of all exit doors in the room by 0.2 inch per person. Clear width is the width of the opening through the fully open doorway, not the width of the door frame. This step usually applies only to large rooms. The maximum occupant load will be the lesser of this number or the number you calculated in any of the above steps.
 4. The facility manager shall report changes to occupancy capacities to the JSC Facility Manager Coordinator yearly for updating the conference room capacity directory in the phone book and on line.
- d. Post occupant loads at the entrance to all conference rooms and other assembly areas with an occupant load of 50 or more persons. For rooms or assembly areas with occupant loads of fewer than 50 persons, you may list the occupant load on table tents or signs inside the room in the assembly area.

11. Controlling the maximum occupant load

Facility managers, those who reserve conference rooms, and those sponsoring or chairing meetings all have a role in making sure occupant loads aren't exceeded:

- a. If you are a facility manager, you shall remove excess chairs in conference rooms to meet occupancy loads. Chairs may be added up to the maximum calculated occupant load.

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- b. If you take reservations for conference rooms, you shall provide information or documentation about the occupant load responsibilities to those who use rooms. This information is available from the facility manager.
- c. If you sponsor or chair a meeting in an assembly room or area, you shall make sure that the posted occupancy load isn't exceeded. In the event of an emergency, you are responsible for safely evacuating the meeting attendees.
- d. Meeting attendees may be seated or standing as long as the occupant load isn't exceeded. Exceptions to this rule are:
 - 1. You shall include physically challenged individuals in wheelchairs who cannot use fixed seating in the occupant load count.
 - 2. Don't include event fire marshals in the occupancy count, in large areas such as the Building 2 auditorium, the Building 30A auditorium, or the Gilruth Center.
 - 3. Persons are not allowed to stand in the aisles in a room with fixed seating. See paragraph 10a, above.
- e. The Safety and Test Operations Division will monitor compliance with these requirements.

12. Fire extinguishers

You need to know that:

- a. You shall never try to put out fires unless you have had fire extinguisher training.
- b. Fire extinguishers are installed in JSC facilities regardless of the fire control measures.
- c. If you see smoke or a fire, call your emergency number and start an evacuation BEFORE using an extinguisher. Don't depend on the fire extinguisher alone to put out the fire.
- d. Portable fire extinguishers are designed to put out small fires when they first start. To use one successfully you need to have:
 - 1. An extinguisher nearby and in good working order.
 - 2. The proper type of extinguisher for the class of fire that occurs. See the glossary for "classes of fire" definitions.
 - 3. A small enough fire for the extinguisher to be effective.
- e. If you elect to use a fire extinguisher, always maintain a clear path to an exit.
- f. You shall not move fire extinguishers in buildings to another location without coordinating with the on-site Fire Protection Emergency Services Coordinator, x35324.
- g. Forklifts, other powered industrial trucks, and digging equipment shall be equipped with a fire extinguisher in good working order. The equipment operators shall inspect the extinguishers monthly. Mount fire extinguishers horizontally on this equipment to minimize the affects of settling of the extinguishing powder.

- h. Fire extinguishers located in buildings shall be mounted on a wall with the bottom at least 4 inches off the floor.

13. Fire safety practices

Good housekeeping is an effective way to prevent fires and allow quick evacuations and access to emergency equipment. You shall follow these practices:

- a. Keep all offices, workplaces, passageways, storerooms, break rooms, and service rooms free from items that could restrict an orderly evacuation or block access to emergency equipment if a fire occurs. Avoid excessive paper and other combustibles in your work area as that can increase the fire load. NOTE: A messy desk isn't necessarily an increased fire load, but large stacks of paper in an office or other area are. See additional information in Chapter 5.2.
- b. Provide containers to separate waste, trash, oily rags, used rags, and other refuse if necessary. Use covered metal containers for garbage, oily wastes, flammable wastes, or hazardous wastes.
- c. Provide metal cans with tight-fitting, self-closing lids where cloth rags or paper towels saturated with oil, paint, ink, or other combustible or flammable liquid are found. These areas could include vehicle and aircraft repair shops, paint shops, printing or reproduction areas, and essential electronic equipment areas. These cans shall be emptied at the end of each work shift.
- d. Store all loose rags, whether used or unused, in a self-closing, approved metal container.
- e. Never store anything in mechanical and boiler rooms, electrical equipment rooms, halls or corridors, utility tunnels, and stairwells. Never store anything under stairs.
- f. Never use wooden waste containers near electrical equipment or other ignition sources. NOTE: Small wooden wastebaskets found in offices are allowed.
- g. Use only metal trash cans with self-extinguishing or garbage-can-type lids in computer rooms.
- h. Keep the wall space above coffee pots, microwaves, and other ignition sources clear of paper, posters, and other combustible material.
- i. Do not overload receptacle circuits with too many coffee pots, microwaves, refrigerators, or other appliances.
- j. Keep combustible trash and debris from accumulating by:
 - 1. Doing a periodic (at least yearly) housecleaning to remove things that no longer serve a useful purpose. This is especially important in offices and research laboratories where large amounts of publications, files, and loose paper may be found.
 - 2. Putting trash and rubbish in approved containers daily.
 - 3. Removing waste from buildings daily or often enough to prevent an excessive accumulation of waste.

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4. Doing a daily housecleaning in areas that generate a large quantity of combustible trash and debris, such as woodworking shops or building construction sites. Remove all refuse from the area or deposit it in appropriate receptacles.
5. Providing enough waste cans in all areas.
- k. Do not allow paper or other combustible materials to fall or rest on power strips, tombstones, or other electrical devices.
- l. Keep at least a 44-inch path open in corridors, stairs, and major hallways. Keep at least a 36-inch path open for other passageways you use to reach an exit such as your work area, aisles, stairs, ramps, and doors. Stairs may be 36 inches wide where the total occupant load of all stories served by the stairs is fewer than 50 people. See paragraph 9 of this chapter.

Requirements for flammable materials

14. How to store, handle, or transport flammable materials

To store, handle, or transport flammable materials, you shall follow these requirements:

- a. For compressed gases, follow the requirements in Compressed Gas Association Pamphlet CGA P-1-2000, "Safe Handling of Compressed Gases in Containers," as found in 29 CFR 1910.101(b), "Compressed Gas Cylinders."
- b. For flammable and combustible liquids, follow National Fire Protection Association Standard 30, "Flammable and Combustible Liquids Code," NFPA-704, "Safety Standard for Fire Protection," and this chapter which, in some cases, is more stringent. Combustible liquids shall meet the same requirements as flammable liquids when they are heated to or above their flash points.
- c. This chapter applies only to storing and handling of ordinary flammable and combustible liquids, such as gasoline, alcohol, and kerosene. You may have to follow additional requirements to safely store and use liquids that:
 1. Have unusual burning characteristics.
 2. Could self-ignite when exposed to air.
 3. Are highly reactive with other substances.
 4. Are subject to explosive decomposition.
 5. Have other special properties that require greater safeguards than this chapter requires.
- d. Never use flammable liquids for cleaning purposes other than in dip tanks that meet National Fire Protection Association Standard 30 standards.
- e. Identify and label all containers of flammable and combustible liquids as described in Chapter 9.2, "Hazard communication," of this Handbook. You may use the National Fire

Protection Association's segmented diamond symbol (National Fire Protection Association Standard 704) to show the health hazard, flammability, and reactivity of the liquid on the container.

15. Flammable and combustible liquids

As defined by the most recent version of National Fire Protection Association Standard 30, "Flammable and Combustible Liquids Code":

- Flammable liquids have a closed cup flash point below 100°F (37.8°C) and have a vapor pressure at or below 40 psia (2068 mm Hg) at 100°F (37.8°C). They are known as Class I liquids.
- Combustible liquids have a closed cup flash point at or above 100°F (37.8°C). They are known as Class II and III liquids.
- The following table gives the basic criteria for the classes.

<i>Type</i>	<i>Class</i>	<i>Flash point</i>	<i>Boiling point</i>
Flammable	IA	Below 73°F (22.8°C)	Below 100°F (37.8°C)
Flammable	IB	Below 73°F (22.8°C)	At or above 100°F (37.8°C)
Flammable	IC	At or above 73°F (22.8°C) and below 100°F (37.8°C)	N/A
Combustible	II	At or above 100°F (37.8°C) and below 140°F (60°C)	N/A
Combustible	IIIA	At or above 140°F (60°C) and below 200°F (93°C)	N/A
Combustible	IIIB	At or above 200°F (93°C)	N/A

16. Safely storing flammable or combustible liquids outdoors

You shall follow these requirements, as described in National Fire Protection Association Standard 30 (2000), subsection 4.7:

- May store flammable or combustible liquids contained in flammable liquid storage cabinets next to a building. Paragraph 16, except subparagraph 16.d, below, applies.
- Locate flammable or combustible liquids stored in a hazardous materials storage locker a minimum of 20 feet from the nearest building. Refer to National Fire Protection Association Standard 30 (2000), subsection 4.6.
- For flammable or combustible liquids stored in closed containers but outside approved flammable liquid cabinets or lockers, maintain the following distances from adjacent buildings:

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<i>Class</i>	<i>Maximum Quantity, gallons</i>	<i>Distance From Building, feet</i>	<i>Distance to Street, feet</i>
IA	1100	50	10
IB	2200	50	10
IC	4400	50	10
II	8800	25	5
III	22000	10	5

1. If the total quantity stored does not exceed 50 percent of the maximum quantity listed in the above table, the distances can be reduced 50 percent, but not less than 3 feet.
2. When two or more classes are stored together, the most stringent requirements apply.
3. If the adjacent building meets the construction requirements of National Fire Protection Association Standard 30 (2000), subsection 4.7.2, the closed container can be placed next to the building.
- d. Clear all dry grass, weeds, and other combustibles around the storage area for a minimum distance of 50 feet from any container storage.
- e. For assistance, contact the Safety and Test Operations Division..

17. Safely storing flammable or combustible liquids indoors

If you store flammable or combustible liquids indoors, you shall:

- a. Store flammable liquids in approved flammable liquid storage cabinets, as described in National Fire Protection Association Standard 30 (2000), subsection 4.3.
- b. Mark cabinets with conspicuous lettering: FLAMMABLE – KEEP FIRE AWAY.
- c. Never store more than 120 gallons of Class I, Class II, and Class IIIA liquids in one storage cabinet. Never include more than 60 gallons of Class I and Class II liquids in the 120-gallon total.
- d. Never have more than three such cabinets in a single fire area. In an industrial occupancy fire area, you may have additional cabinets in the same fire area if:
 1. You keep them in groups of no more than three.
 2. You have at least 100 feet between each group of cabinets.
- e. Make sure the manufacturer's bungs are in place if the cabinets aren't vented to the outside of the building.
- f. Never store cylinders of propane or other flammable gases in flammable liquid storage cabinets.
- g. Venting of flammable liquid storage cabinets is not recommended for fire protection purposes. However, if the cabinet is required to be vented by the Clinic Services Branch, you shall vent the cabinet directly to the outdoors. Vent systems shall not

decrease the ability of the cabinet to protect the contents in a fire. A fire protection engineer in the Safety and Test Operations Division must review and approve proposed vent designs before installation.

18. Using other indoor storage facilities

If larger quantities of flammable or combustible liquids than allowed in paragraph 16 are required to be stored inside, the room requirements are based on the liquid quantities and type room involved. Contact a fire protection engineer in the Safety and Test Operations Division for assistance.

- a. All electrical equipment in inside rooms used for storing Class I liquids shall meet the requirements for Class I, Division 2, locations as defined in Articles 500 – 501 of National Fire Protection Association Standard 70, “National Electrical Code.” Ordinary electrical equipment is acceptable in areas that store Class II and III liquids if you never store Class I liquids in that area.
- b. Storage limitations and guidelines for inside storage rooms shall follow National Fire Protection Association Standard 30 (2000), subsection 404.
- c. Inside storage rooms where liquids are dispensed have special storage limitations. See National Fire Protection Association Standard 30 (2000), subsection 404.

19. Storing small quantities of flammable or combustible liquids in an office or wet laboratory environment

- a. In an office or a business environment, you shall follow National Fire Protection Association Standard 30, “Flammable and Combustible Liquids Code.” Also limit the quantities to the amount required for operation of office equipment, maintenance, demonstration, and laboratory work, with the following limits:
 1. Approved metal or plastic containers of flammable liquids that are stored outside of a flammable liquid storage cabinet shall not exceed a capacity of 1 gallon. When stored in approved safety cans, the maximum amount is 2 gallons.
 2. You may store no more than 1 pint of Class 1A liquid and no more than 1 quart of Class 1B liquid in glass containers outside of a flammable liquid storage cabinet.
 3. You may store no more than 5 gallons of flammable and combustible liquids, combined in a single fire area outside of flammable liquid storage cabinets. When stored in an approved safety cans, the maximum amount is 25 gallons.
- b. Storage of flammable and combustible liquids in wet chemical laboratories shall meet National Fire Protection Association Standard 45, “Standard on Fire Protection for Laboratories Using Chemicals.” This standard has different requirements for storing flammable and combustible liquids than National Fire Protection Association Standard 30, “Flammable and Combustible Liquids Code.” A “wet chemical” laboratory is one whose primary activity is mixing and using liquid chemicals.

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- c. See the following table for the combined quantities (gallons) of flammable and combustible liquids you may store in a wet chemical laboratory

	Excluding Quantities in Storage Cabinets or Safety Cans		Including Quantities in Storage Cabinets or Safety Cans	
	Max. Quantity per 100 ft ² of Laboratory Unit (gallons)	Max. Quantity per Laboratory Unit (gallons)	Max. Quantity per 100 ft ² of Laboratory Unit (gallons)	Max. Quantity per Laboratory Unit (gallons)
Sprinklered	1.1	75	2	150
Non-sprinklered	1.1	37	2	75

NOTE: A “laboratory unit” is laboratory space separated from other parts of the building by fire-resistant construction. Without any separation, the entire building becomes the “laboratory unit.” Contact a fire protection engineer in the Safety and Test Operations Division if you need help.

20. Handling large quantities of flammable or combustible liquids

Follow these requirements for handling large quantities of flammable or combustible liquids:

- You shall transfer, dispense of, or mix Class I or Class II liquids in quantities larger than 5 gallons only in facilities specifically designed and constructed for such operations. The Safety and Test Operations Division must approve plans and specifications for such buildings.
- Never fuel vehicles in a building unless you are authorized to do so in writing by the Safety and Test Operations Division. Vehicles in facilities shall have full fuel tanks.
- Store flammable liquids that require refrigeration in explosion-proof refrigerators or freezers.
- Refer to National Fire Protection Association Standard 30 (2000), subsection 4.5.2, for requirements for storing flammable or combustible liquids in warehouses.

21. Responsibilities under JSC’s fire safety program

The following individuals and organizations have responsibilities under the fire safety program:

- As an *organizational director*, you are responsible for:
 - Carrying out JSC’s fire safety program described in this chapter.

- Evaluating your operations and valuable inventories to make sure that no undue fire risks exist. A fire protection engineer from the Occupational Safety and Quality Assurance Branch can help you do risk assessments or help you by providing technical assistance and fire code interpretations.
- b. As a ***facility manager***, you are responsible for managing the fire safety program in your facility with the help from the line managers, contract project managers, and assistant fire wardens. This includes the following:
- Make sure everyone in your building follows facility fire rules, regulations, and fire codes. This is done through education and training in the causes and prevention of fires.
 - Be aware of all maintenance or construction work that takes place in your facility and the associated fire risk it may create.
- c. JSC's ***Center Director*** is responsible for appointing, in writing, a safety or fire protection professional as the "Authority Having Jurisdiction" for fire protection at JSC.
- d. The ***Safety and Test Operations Division*** is responsible for:
- Overseeing the fire safety program with emphasis on facility fire protection.
 - Directing the technical aspects of the JSC fire protection activity, including the provision of adequate firefighting and rescue capabilities.